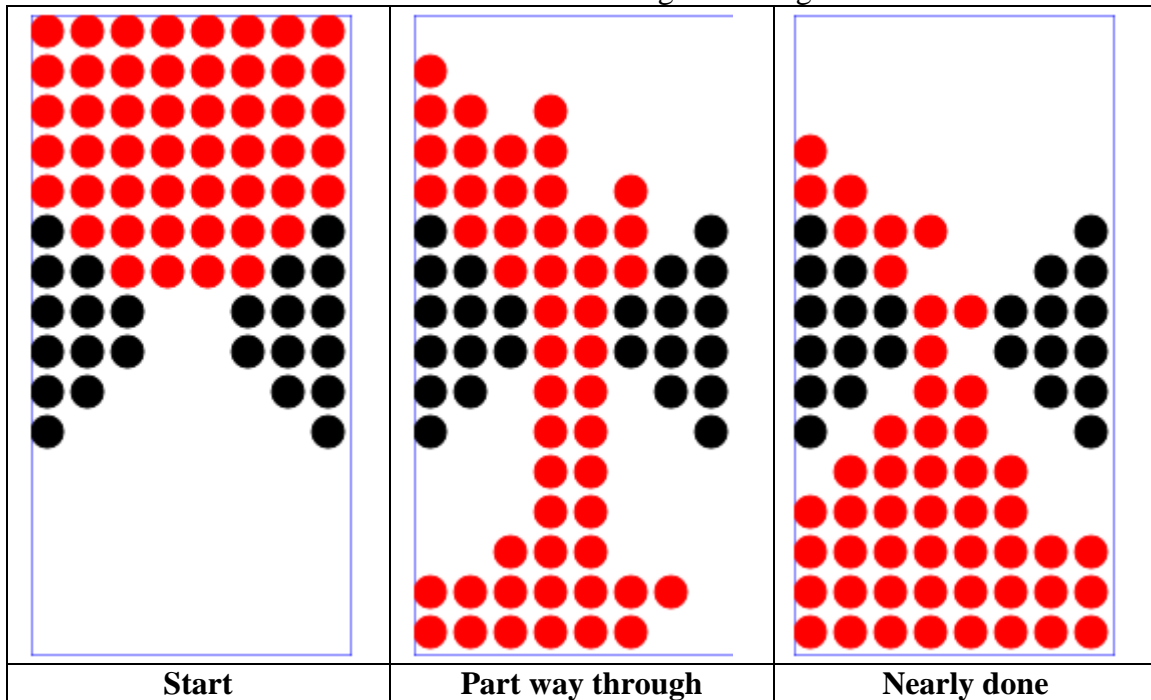


**EE 354**  
**Project 1**  
*Hour Glass Figures*

**Assigned: August 22, 2018**  
**Due: October 19, 2018**

**Description**

For this project you will simulate sand falling through an hour glass using two 8 x 8 LED matrix displays (total of 128 LEDs) and an accelerometer configured as a level sensor. Figure 1 shows what the hour glass simulation might look like on your LED display. The red dots are the LEDs that are on and represent the falling sand. The black dots are the LEDs that are off and show the borders of the hourglass configuration.



**Figure 1**

Sand falling through an hour glass. Sand is represented by red LEDs. The three figures show a sequence as the sand falls through the hour glass.

Your hour glass must be sensitive to gravity so that if it is turned upside down the sand falls in the other direction. This should happen even if the sand has not all fallen through – that is you turn it over before it completes. Likewise, if you turn the hour glass on its side the sand should fall to that side.

**LED Arrays**

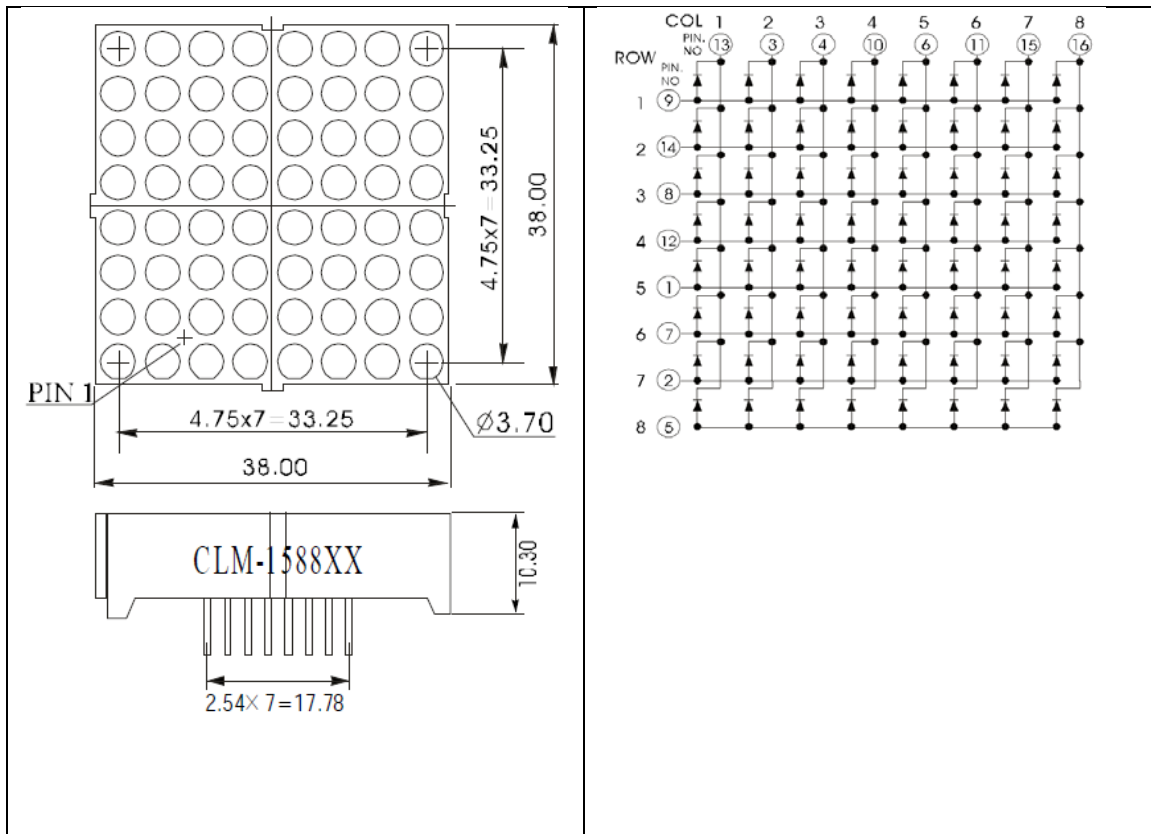
LEDs

We will use two arrays of LEDs where each array has 8 x 8 diodes arranged in a square. A typical 8 x8 array is available here:

<https://www.datasheets360.com/pdf/4368546661359715048>

The CLM-1588B array is 1.5 inches square and we will use this in class. There are other arrays available in different sizes and colors. See Jeff Cron if you would like to get something different for your project.

The physical arrangement of the LEDs and a circuit diagram for a single 8 x 8 array is shown in Figure 2.



**Figure 2**

An array of 8 x 8 LEDs. Note that there are 64 diodes but only 16 pins where each pin is a common cathode or common anode for 8 LEDs. By making a cathode line low and an anode line high you can turn on any one LED. This is the pinout for the CLM-1588B array. Other arrays that look similar may have a very different pinout.

### **Specifications**

1. The hour glass container which you build must fit within a container that is no larger than 6" x 8" x 2". Nothing may extend beyond this boundary – this include switch handles, knobs, LEDs, etc.
2. The hour glass must be completely self-contained and battery operated.
3. The hour glass must be sturdy enough to survive a four foot drop onto a concrete floor.
4. You must use the AT89C51CC03 processor to drive your hour glass.
5. You must have an on/off switch and a reset switch. The user should not have to open you container to turn it on or off or to reset it.

6. Your container must be relatively water resistant. For testing purposes 8 ounces of water will be poured over each game while it is running. This water must not impede the game in any way.
7. Your container must be secure and should not rattle when shaken.
8. You must provide a mechanism for changing the batteries that does not require disassembly. Removing one or two screws is acceptable.
9. Your software must contain at least one subprogram in C and at least one subprogram in 8051 assembler.
10. Your project must consider the following factors in the design: safety, manufacturability, economic, environmental, and reliability.

Variations on the original hour glass are encouraged.

***Grading:***

This project will be done individually and a single grade will be given for each project. A total of 100 points is available for the project and will be awarded on the following basis:

<b>Points</b>	<b>Item</b>
25 points	Does your project work and meet specifications
15 points	Creativity and novel added features
15 points	Finished product quality
15 points	Documentation of software
15 points	Documentation of hardware
15 points	Other documentation

The project report should consist of:

- A cover sheet with your name, the project number and title, and the date turned in.
- A list of novel features. Creativity may consist of novel hardware or software implemented features or a novel packaging technique.
- A list of those items you were able to demonstrate as working to the instructor.
- A discussion of how you considered safety, reliability, economic, manufacturability, and environmental factors.
- An estimate based on theoretical and empirical data as to the power requirements.
- Hardware documentation.
- Software documentation.

At a minimum your hardware documentation must consist of a system diagram, a complete circuit diagram (with pin numbers), and a mechanical sketch or photo of your project done to a level of detail such that another person in the class could build your project from your diagram. At a minimum your software documentation should consist of fully commented source code for all of the modules in your program and a pseudocode design with enough detail that another person in the class could duplicate the function of your software.

Revised: August 17, 2018

The grade for this project will be based on what is complete and handed in as of ***11:00am on October 19, 2018. No late grades will be given.***